FA PGMs

Revolutionizing Fires for the Ground Force Commander

By Colonels Gary S. Kinne, John A. Tanzi and Jeffrey W. Yaeger

For the first time in the history of any military, the US warfighting ground force commander has *organic*, surface-to-surface, all-weather fires options for rapidly and *precisely* taking out a wide array of targets in a variety of terrains, some targets ranged from as far away as 270 kilometers.

Two of the newest of these FA precision-guided munitions (PGMs)—the guided multiple-launch rocket system (GMLRS) unitary and 155-mm Excalibur unitary—are *scalable*, optimizing them for employment in restricted, urban or complex terrain and (or) in close support of troops at ranges from 7,200 meters up to 70 kilometers with a circular error probable (CEP) of much less than 10 meters—ideal for kinetic operations in the Global War on Terrorism.

GMLRS unitary has been in the Central Command (CENTCOM) theater since June 2005, demonstrating its precision in combat operations. Based on Excalibur unitary's performance during developmental testing, it soon will set the same accuracy standard when it's fielded in the fires battalion in the CENTCOM theater in early 2007.

Additional FA precision programs are under development to make cannon area fire conventional munitions more precise and enhance rocket and missile effects for the ground commander by filling warfighting gaps. Two of the developmental PGMs will be organic to the brigade combat team (BCT) and capable of attacking moving targets—one of which will be in the inventory starting as early as 2008.

Because these new and developmental FA precision-strike capabilities are producing a wide range of effects on all terrain at extended ranges and are all-weather, scalable and available to the ground commander organically, they are revolutionizing the way the commander thinks about warfighting.

These new and developmental FA PGMs complement the air-delivered joint direct attack munition (JDAM), the Air Force's PGM most frequently

Soldiers look over the results of a test of the guided multiple-launch rocket system (GMLRS) unitary on a building in Iraq in June 2005.

employed in support of ground forces at the tactical and operational levels of warfare. JDAM comes with a 500-, 1,000- or 2,000-pound warhead. Less frequently employed in support of tactical and operational ground forces, the Air Force has two laser-guided bombs: Guided Bomb Unit (GBU)-12 (500-pound warhead) and GBU-10 (2,000-pound warhead).

These joint PGMs (JPGMs) give the ground force commander a range of options from blowing up entire complexes precisely with JDAM or GBU to blowing up a mortar crew precisely with FA PGMs—and options in between.

This article describes recently and soon-to-be fielded FA rocket, missile and cannon PGMs, ways in which FA precision munitions can be employed plus a quick look at future FA precision programs. In addition, the article discusses how the forward observer (FO) on the front lines now can rapidly provide the targeting data required for a precision strike that, until recently, could be provided only at the theater level.

Advantages of the New PGMs. The new PGMs bring a number of advantages to the ground force, including increased combat effectiveness, improved flexibility and a reduced logistical burden.

Increased Combat Effectiveness. PGMs are simply more accurate than ballistic or free-flight munitions. While one round fire-for-effect missions are possible using conventional munitions, in most cases volume is used to compensate for the inherent inaccuracies of a given indirect fire weapons system.

Additionally, effectiveness decreases as timelines for the munitions' impact increase because targets have time to move or assume more survivable postures. PGMs increase effectiveness by delivering effects precisely on target before the enemy knows they are coming—either because the JDAMs or GBUs are dropped from high altitudes or the FA PGMs in the fires battalions organic to the BCTs or in the fires brigades can be fired rapidly at the direction of the ground commander needing the effects.

Improved Flexibility. It is a tactical and operational fact that the rules of engagement (ROE) and collateral damage estimates (CDEs) drive the targeting decision-making process. Targets within "urban canyons" pose a particular set of challenges and, until recently, were almost the exclusive fires domain of the Air Force or Army helicopters.

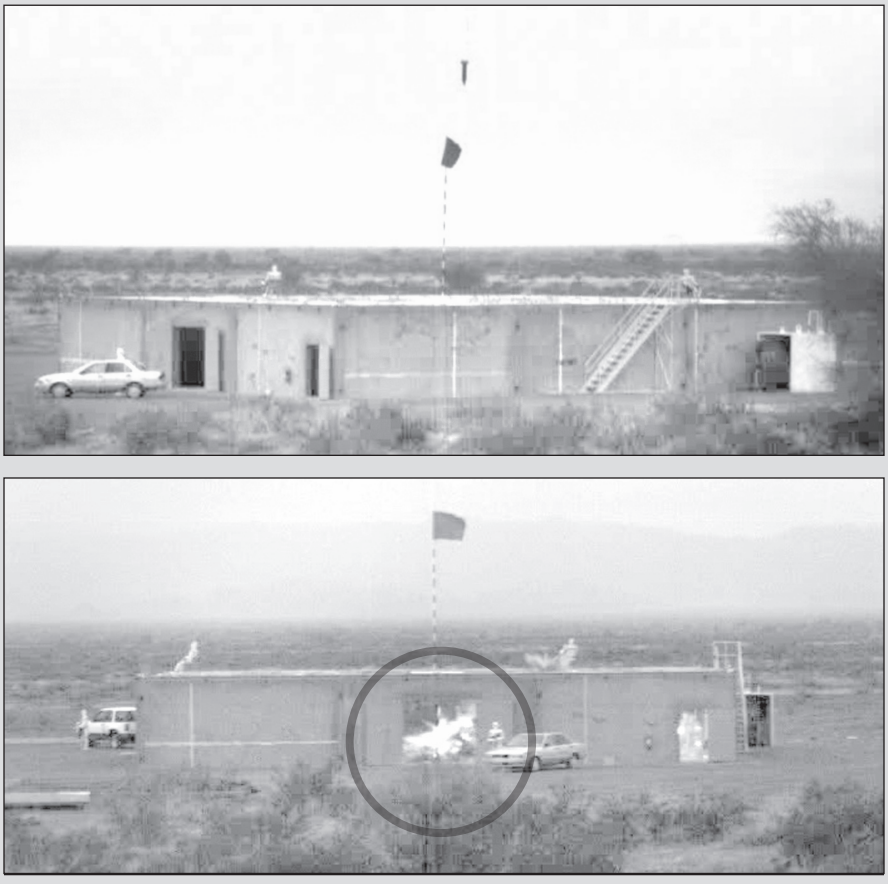
The advent of surface-to-surface PGMs with focused warheads, such as the Army tactical missile system (ATACMS) Block IA quick-reaction unitary (QRU) missile (the FA's first "fire-and-forget" precision unitary warhead munition), GMLRS unitary and Excalibur unitary give commanders at all levels additional options with which to attack a target rapidly. It no longer will be necessary to wait for an aircraft or nominate targets in the air tasking order (ATO) process to employ precision effects. Depending on the ROE, the FA PGM employed and the designated coordinating altitude (fixed-wing "stay-above" altitude), an FA PGM may be employed immediately after the ground commander clears the fires—the same commander who requested the precision strike and owns the battlespace. For example, if the enemy fires a rocket-propelled grenade (RPG) at Coalition Forces, a GMLRS unitary or Excalibur unitary could be cleared to fire very rapidly and eliminate the RPG insurgents while "the neighbors" across the street remain safe.

Surgical strikes by surface-fired PGMs will become common in operations spanning the full spectrum of operations.

Reduced Logistical Burden. On a per-target basis, precision engagements will reduce ammunition logistics tails drastically when compared to the logistics tails of traditional ballistic or free-flight munitions. Battery massed missions and entire launcher/cannon loads fired at single targets will be replaced by single rocket/missile/round missions, in some cases.

The number of missions per platform will increase as firing platforms achieve the desired effects without expending their entire ammunition loads. Launchers (M270A1 and the high-mobility artillery rocket system, or HIMARS) and cannons loaded with PGMs will spend less time reloading with more time left "operationally ready" for the mission.

Rocket and Missile PGMs. Large bursting radii and several variants of munitions dispensing an extensive volume of submunitions generally characterized the FA arsenal of rockets and missiles during the Cold War era. In fact, the enemy in Operation Desert Storm (ODS) called MLRS "Steel Rain" because of its volume, distribution and



Still frame images taken from video footage show an incoming 155-mm Excalibur unitary round close to the dead-center of its target in a near-vertical descent after being fired on a structure from 22 kilometers away. The bottom image shows the round, functioning in the delay mode, detonating after penetrating a four-inch concrete roof.

Photo by SSG James H. Christopher III, 55th Signal Company (Combat Camera)

2nd Battalion, 20th Field Artillery, 4th Fires Brigade, fires a GMLRS rocket in Iraq from Forward Operating Base Q-West, Qayyarah, on 5 January. The unit fired a terrain denial mission on an area where insurgents were known to position mortars and rocket launchers.

effects on them. The enemy was describing MLRS dual-purpose improved conventional munition (DPICM) submunitions dispensed by the hundreds across large areas of the desert by the M26 rocket launched from the M270 MLRS launcher in ODS.

What Saddam Hussein's soldiers could not have known in 1991 was that 14 years later, the new M270A1 MLRS launcher would fire GMLRS unitary rockets against insurgents inside Iraq. But this time, there would be no Steel Rain—only a sudden explosion and flash of light as the rocket destroys, say an improvised explosive device (IED) lab, leaving the building next door virtually undamaged.

XM31 GMLRS Unitary. In October 2004, the Commanding General of the MultiNational Corps Iraq (MNC-I) signed an urgent needs statement (UNS) asking for a longer range, indirect fire weapon that could be fired precisely into an urban environment with a low probability of collateral damage and, at the same time, leave no unexploded ordnance. In January 2005, Headquarters, Department of the Army directed a response to the UNS, resulting in a limited quantity of GMLRS unitary rockets' being sent to Iraq in June 2005. Although full-rate production of the GMLRS unitary is not anticipated until 2009, the PGM joined the fight in the CENTCOM theater last summer.

GMLRS unitary rocket can engage targets at ranges from 15 to 70 kilometers with two fuzing options: point detonating (PD) and delay. In the future, a proximity fuze mode will be added.

The target sets for GMLRS unitary consist of stationary targets including structures (buildings, bridges, reinforced bunkers, etc.), lightly armored vehicle arrays and personnel.

In an actual firing in the CENTCOM theater, a GMLRS unitary rocket delivered a single 200-pound class warhead that exploded a few milliseconds after it penetrated the roof of an Al Qaeda safe house. The M270A1 launcher that fired the single rocket was more than 60 kilometers away.

Although rockets traditionally have not been used in the close support role, the precision effects demonstrated by GMLRS unitary rockets is causing commanders and planners to re-think attack matrices. The range, limited collateral damage and accuracy of GMLRS unitary rockets lend themselves not only to shaping and counterstrike roles, but also to close support. GMLRS unitary can impact safely within 200 meters of friendly forces—sometimes even closer, depending on the circumstances.

Today, GMLRS unitary is the Army's only surface-fired, precision, longer range indirect fire munition available to troops in contact in an urban environment.

In September 2005, the 3rd Battalion, 13th Field Artillery (3-13 FA), 214th Field Artillery Brigade, in support of the MNC-I, fired GMLRS unitary rockets for the first time in combat operations. 3-13 FA fired them during Operation Restoring Rights at Tal Afar and Operation Sayaid in the Al Anbar Province in western Iraq. During Operation Restoring Rights, eight GMLRS unitary rockets were fired, destroying two insurgent strongholds and killing 48 insurgents from a distance of 50 kilometers away. One day later during Operation Sayaid, 3-13 FA fired six rockets and destroyed the Mish'al Bridge, preventing insurgents in the Al Anbar Province from using it.

M48 ATACMS Block IA QRU. In the inventory for approximately four years, the fire-and-forget ATACMS Block IA QRU is a PGM that offers a "big brother" alternative to the precision focused effects of GMLRS unitary. The ATACMS QRU's 270-kilometer range and 500-pound unitary warhead increase the commander's reach and blast effects with its PD fuze without sacrificing pinpoint accuracy.

During the initial phase of Operation Iraqi Freedom (OIF), 13 ATACMS QRUs were fired at command and control (C^2) nodes and achieved tremendous success. The target sets for ATACMS QRU consist of stationary targets, including structures (buildings, bridges, C^2 nodes, bunkers, etc.), lightly armored vehicle arrays, logistical sites and personnel. Like GMLRS unitary, ATACMS QRU's unitary warhead eliminates the possibility of unexploded ordnance (submunitions).

The range and precision of ATACM QRU make them ideal for shaping and counterstrike missions. Although certainly capable of being employed against targets in urban terrain, commanders and staffs must plan for the larger collateral damage radius associated with ATACMS QRU's 500-pound warhead as compared to GMLRS unitary's 200-pound warhead.

M30 GMLRS. This PGM is the next generation of DPICM rocket and has a range of 70 kilometers. It is guided by a global positioning system- (GPS)-aided inertial measuring unit (IMU) to create an accuracy of less than one mil at all ranges.

The M30 GMLRS leaves significantly fewer duds on the battlefield as compared to the M26 DPICM rocket employed in major combat operations in OIF. The GMLRS submunition dud rate has been reduced to two percent at most ranges. In addition, the rocket carries one-third fewer submunitions (404 as compared to the M26's 644 submunitions). The number of duds on the battlefield also is reduced significantly by the GMLRS' decreased volume of fire as a PGM. So, fewer PGM rockets will be fired to get

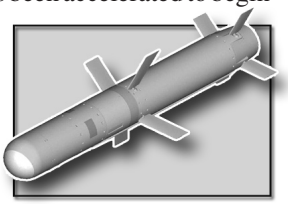
the desired effects on target, and each rocket will have fewer submunitions with a reduced dud rate.

As an area munition, GMLRS fills a warfighting gap by providing precision effects on targets not suitable for unitary munitions. It gives commanders precise destructive or protective/suppressive fires against target arrays or expanded target areas too large for unitary warheads. It also can be employed to mitigate less than optimal sensor target location errors (TLEs). Whereas unitary warheads need "tight" target location accuracy, GMLRS can accept a slightly larger error and still provide effects on the target.

M270A1 and HIMARS can fire GMLRS, which currently is in full-rate production and being stocked in the inventory.

Future Rocket and Missile Precision Programs. Two additional munition variants are scheduled for inclusion in the FA's rocket and missile PGM inventory: the precision attack missile (PAM) and loiter attack missile (LAM). They are part of the non-line-of-sight launch system (NLOS-LS). These two future PGMs address warfighting capabilities gaps and are designed for specific target sets, giving ground commanders expanded options for precisely attacking point targets. Of note, PAM and LAM will be able to attack moving targets through responsive networked fires and will be organic to the BCT.

• PAM is one of only three future combat system (FCS) weapon systems whose development has been accelerated to begin fielding to the evaluation BCT (EBCT) at Fort Bliss, Texas, in FY08.



It is a solid-propellant precision-guided missile that will be fired remotely from container launch units (CLUs). Each CLU will contain 15 PAMs and a command, control and communications capability. PAM will receive fire missions from the advanced FA tactical data system (AFATDS) (modular force) or battle command network (FCS force). The CLUs will be transportable by truck or sling loadable under helicopters.

The missile will have various flight profiles enabling it to be employed against a wide array of targets, including moving targets, to a range of 40 kilometers (threshold) with the objective of 60 kilometers. Each missile will receive target location and description data before launching and use GPS guidance (with inertial backup) to fly to the target location. The missile will search the target area during the terminal portion of the flight and make corrections to hit the target (using its uncooled imaging infrared seeker with a semi-active laser) or fly directly to the target guided by a laser designator from an external observation platform. The missile will be able to receive a target location update while in flight, allowing it to engage moving targets.

PAM will be effective against both heavy and soft targets. Commanders will be able to employ it in a number of different scenarios across the spectrum of operations from stability and reconstruction operations (S&RO) to major combat operations. The fires battalion in a modular BCT will have PAM, giving the BCT commander organic PGMs effective against moving targets—long the "Achilles heel" of the Field Artillery.

• LAM also will be fired from CLUs, much like PAM. It will be able to attack stationary, moving and fleeting high-payoff targets (HPTs) at extended ranges, defeating lightly armored and soft targets with precision using GPS guidance. It also will be able to provide surveillance and targeting images to support battle damage assessment (BDA) and serve as an airborne radio retransmission platform. LAM's threshold range and loiter time will be 70 kilometers with a 30-minute search time up to the objective range of 100 kilometers with a 45-minute loiter time.

The commander will have the option of employing LAM in the fire-and-forget or man-in-the-loop mode. Using its primary seeker (laser radar, or LADAR) and automatic target recognition templates, the missile will be able to locate and recognize targets, transmit target images and attack targets. Fire mission instructions, including image collection options, attack criteria and search patterns, will be programmed in LAM before it is launched, but the operator will be able to update the data while LAM is in flight.

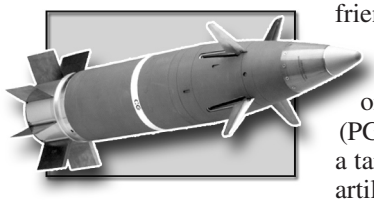
As with PAM, LAM will be organic to the BCT.

For more information on these rocket and missile precision-strike programs, see the Training and Doctrine Command (TRADOC) Systems Manager for Rocket and Missile Systems (TSM RAMS) link on Fires Knowledge Network (FKN) on Army Knowledge Online (AKO) or email tsm.rams@us.army mil.

Cannon PGMs. The FA soon will field the Excalibur unitary PGM and has several cannon precision programs under development.

Soldiers train to download container launch units (CLUs). The CLUs can carry the precision attack missile (PAM), the loiter attack missile (LAM) or a mixture both.

XM982 Excalibur Unitary. In August 2004, the Commanding General of III Corps in Iraq submitted a UNS requesting a precision cannon round that is effective in urban operations—Excalibur unitary is the response. It will be fielded in the CENTCOM theater not later than the Second Quarter of FY07. The Excalibur unitary development program was accelerated by two years to meet the UNS deadline.



Excalibur unitary is an extended-range 155-mm high-explosive (HE) PGM capable of engaging HPTs in all weather and terrain while minimizing collateral damage through concentrated lethality and increased precision. The Paladin self-propelled howitzer, M777A1 lightweight 155 or the NLOS cannon will be able to fire Excalibur unitary.

Using a non-ballistic flight path, Excalibur unitary is achieving a range of 24 kilometers in testing with the objective range of 40 kilometers with base-bleed integrated. Its guidance system is GPS, eliminating the need for laser designation and making it the Army's first cannon-delivered fire-and-forget munition.

PD, delay or proximity fuze settings allow Excalibur unitary to attack multiple target types (soft and medium targets) and reinforced point targets. Its required TLE is 30 meters for enemy personnel or light materiel and 10 meters for structures requiring a direct hit.

With its non-ballistic trajectory, near-vertical terminal dive and 50-pound warhead that can penetrate four inches of steel reinforced concrete, Excalibur unitary produces a highly concentrated and predictable fragmentation pattern, optimizing it for employment in urban operations and allowing targeting staffs to determine the potential for collateral damage during operational planning.

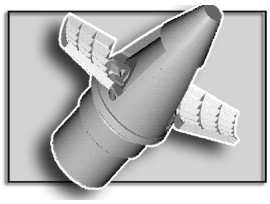
The round will be employed for close support, particularly in urban operations. Although we have not determined Excalibur unitary's risk estimate distance (RED) yet, testing indicates that we will be able to fire Excalibur unitary safely at distances considerably less than 600 meters from friendly forces, the current restriction for danger-close fires.

The ground commander will use Excalibur unitary when collateral damage is an issue; targets are in, on top of or adjacent to a structure (urban environment); weather conditions or response times makes other precision attack assets infeasible; the commander needs to destroy targets in close proximity to friendly troops, civilians or protected targets; precision is needed but beyond-line-of-sight (BLOS) systems or precision-guided mortar munitions (PGMMs) can't range the target; or when a target is out of range of conventional artillery munitions.

Recent tests at Yuma Proving Ground, Arizona, have demonstrated Excalibur unitary's multiple-fuze settings and precision capabilities. Consistently in live-fire tests, Excalibur has impacted within five meters of its targets' aim points when fired from ranges of eight to 23 kilometers.

Future Cannon Precision Programs. Several precision programs are underway for cannon munitions.

• The precision guidance kit (PGK) for both 155-mm and 105-mm conventional cannon munitions, such as HE or DPICM, will make these munitions' area fires more precise. These systems are GPS-guided with some also inertial navigation system- (INS)-aided; the rounds will impact within a 50-meter CEP at all ranges for the initial increment of the PGK and with the objective PGK's CEP reduced to 10 meters.



Although recent operations reinforce the necessity for more precision, the Army continues to need the capability to saturate large areas with fires in high-intensity conflict. With PGK, the ground warfighting commander will be able to fire more precise suppression effects while retaining the traditional option of massing dumb, but deadly rounds for area effects—giving him a robust kit bag of fires effects.

Conventional munitions enhanced with PGKs are projected to start coming into the inventory in FY09.

• To develop 105-mm PGMs, the FA will leverage Excalibur unitary's technology. While still in the early stages of definition, the 105-mm PGM is envisioned to enhance the conventional 105-mm round's precision, extend its range and increase its lethality. PKG enhancements to current 105-mm rounds will bridge the gap until the new 105-mm PGM is fielded.

For more information about the cannon precision munitions programs, see the TSM Cannon link on FKN on AKO or email tsm.cannon@us.army mil.

Providing Precise Coordinates for PGMs. PGMs need precise target coordinates—or these precision munitions will miss their targets "precisely." Today's technology allows the FO at the tactical level to rapidly and easily determine PGM coordinates when previously they only could be determined at the theater level.

Historical Perspective. In the past, determining these coordinates was time-consuming and required target mensuration. The latter is the application of mathematical principles to a two-dimensional surface to determine the most accurate location of a target on all three planes of a Cartesian surface (XYZ). Mensuration greatly reduces TLE using a process to correlate the expected target location to highly refined coordinates. Simply stated, mensuration gives an accurate aim point.

One of the most familiar ways of mensurating target coordinates uses the digital point position database (DPPDB). The DPPDB is a stereo image-based software developed by the National Imagery and Mapping Agency (NIMA), now known as the National Geospatial-Intelligence Agency (NGA), which was introduced in the mid-1990s. The military and intelligence services routinely use DPPDB to derive precise coordinates to support targeting and mission-planning requirements.

The database consists of several dependent components, including rectified aerial imagery and the support data needed to exploit that imagery. Progressive applications, such as Dewdrop, Raindrop and Rainstorm, use the DPPDB for mensuration; their respective accuracies can be found on the NGA secure website.

Until recently, the ability to provide targeting data for a precision strike only was available through mensuration at the theater level. The Air Force initiated efforts to place a mensuration capability at the air support operations center (ASOC) to cut down on the reach-back required. The process still was time-consuming and viewed as not responsive to the immediate needs of commanders on the ground, especially to engage time-sensitive targeting.

Technology for the FO's PGM Coordinates. The precision-strike suite special operations force (PSS-SOF) software allows the observer on the front lines to determine precise coordinates for

PGMs. PSS-SOF verifies the location to be targeted by associating the grid to the DPPDB. This process is a direct transfer from the known points in the DPPDB.

Because true mensuration is performed by highly trained experts at the theater or national level, PSS-SOF has been referred to as "near-mensuration." It is more accurately a three-dimensional determination of coordinates that are precise enough to employ today's PGMs at the tactical level, PGMs such as Excalibur unitary, GMLRS unitary and JDAM.

Using the PSS-SOF, ground-based observers with eyes on the target can determine, refine and transmit precise coordinates to strike assets for precision strike munitions more quickly and easily.

The figure details information on the software. Specific problems, such as a gap in digital interfaces, drove the software's development.

Of note, the NGA has validated the software for PGMs. Units operating in theater now use it. It is part of the US Air Force's tactical air control party (TACP) modernization program and an extension of the Army's FO system under the automated fire support system.

PSS-SOF has been incorporated into Forward Observer Software (FOS), Version 7.0.13, to be fielded in the Fourth Quarter of FY06. It currently is trained at Fort Sill, Oklahoma, in the Joint Fires Observer (JFO) Course and in some of the joint terminal attack controller- (JTAC)-producing schools in other services.

Coordinates Determination Process. PSS-SOF is just one part of the process. The observer determines his own position from his GPS and a range and bearing to the target from his laser rangefinder. The information is digitally transmitted, no "fat fingering." Then the observer pushes this new information to his mission planning software. He must review his mission planning environment where he also is receiving Blue Force updates. On various map displays, such as FalconView, the observer sees his location and target.

Here is where PSS-SOF is involved. The observer digitally passes the data from his mission planner to the PSS-SOF application on the same computer. PSS-SOF automatically pulls up the appropriate images, a stereo pair of two different images of the same target area. The operator locates the intended feature on both images, and PSS-SOF calculates and returns precision coordinates and elevation. The application also presents the coordinates' TLE, which is very important in ROE considerations.

Precision Strike Suite for Special Operations Forces (PSS-SOF)

The observer then digitally transmits the precise coordinates to the system delivering the PGMs. The entire process takes minutes.

The joint services have taken a historical process that required target coordinate refinement from the highest levels and pushed it down to the ground observer to determine precision strike data at his location and have greatly improved the timeline for doing so. This improves joint warfighting and the application of precision strike capabilities.

The Army has entered an era of longer range tactical PGMs, including fire-and-forget PGMs. Although the Army still requires the ability to mass fires with ballistic munitions, recent technological applications and the desire to avoid collateral damage have driven the use of precision munitions.

The Field Artillery continues to evolve and develop new capabilities designed to meet the ever-changing challenges of current and future battlefields.

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